

# CHAPTER M5

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## **M5.00 General**

Safety devices are provided and maintained for the protection and guidance of traffic.

This Chapter includes work in the following Family/Problem areas:

- M5 Roadside Markers
- M6 Guardrail
- M7 Median Barrier
- M8 Vehicle Energy Attenuators (energy dissipaters)
- M9 (portion) -- Out of Control Vehicle Ramps

Unsatisfactory performance or problems with maintenance of traffic safety devices should be reported to the Maintenance Program.

Refer to Volume 2 of the Maintenance Manual, for planning, scheduling and administrative procedures connected with the M family.

The following section (M5.01) discusses maintenance levels applicable to work in the M family program. Sections M5.02 and M5.03 describe the proper use and general guidelines for the various devices and discuss installation and maintenance details and checklists.

## **M5.01 Levels of Maintenance**

The proper maintenance of traffic safety devices is important in providing maximum protection to the traveling public and for general appearance of the roadside. Levels of Maintenance, including frequency and priority of action, are included in Volume 2 of the Maintenance Manual for budgeting purposes. Levels may vary depending on overall appropriation of funds by the Legislature.

### **M5.01.1 Guardrail**

Guardrail should be routinely observed for deficiencies. It should be maintained approximately true to line, grade, and functional height. Timely adjustments should be made to correct guardrail height when the original installation is degraded by the buildup of pavement or shoulder material, shoulder erosion, fill settlement, or any other cause. Missing anchor cables must be replaced.

Damaged rails and bent or missing delineators should be temporarily repaired if an obvious hazard exists or if functional integrity is impaired.

Permanent repair or replacement should be promptly scheduled. Any remaining adjustments to line and grade should be done, when conditions permit, in conjunction with other repair work.

Rail that has previously been painted for delineation should be washed or repainted as needed.

Washing and painting of unpainted rail is not required.

Curved terminal sections on the downstream ends of guardrail adjacent to one way roadways should not be replaced when damaged.

#### M5.01.2 Median Barriers

Removable panels of glare screen at emergency openings that are missing, or damaged, should not be maintained or replaced.

##### (A) Thrie and Metal Beam Barrier

- (1) Surveillance should be made for structural integrity, height, and alignment.
- (2) Repairs should be made promptly if a traffic hazard exists or functional integrity is questionable. Damage not constituting a hazard to traffic or functional integrity should be repaired when the schedule permits.

##### (B) Cable Barrier

- (1) The effectiveness of cable barrier is extremely sensitive to the height of the cable.  
  
Make periodic surveillance for structural integrity, height, and alignment.
- (2) When damaged, temporary repairs should be made promptly by propping up the cable to the height of the adjacent cable and cutting off posts that may be considered an obstacle to traffic.
- (3) Damaged posts should be scheduled for replacement at the earliest practical time.  
  
Posts replaced in sleeves in the foundation may be back filled with concrete sand in lieu of paving asphalt.
- (4) Permanent repairs should be scheduled promptly. Surface irregularities such as berms, or windrows resulting from shoulder grading must not be allowed adjacent to cable barriers.

- (5) Reflectors on cable median barrier will not be maintained when the median edge is delineated by striping and/or raised pavement markers.

(C) Concrete Barrier

- (1) Concrete median barriers generally require little maintenance. Surveillance is necessary to ensure prompt repair when the barrier is broken or pre-cast units are toppled over or knocked out of line.
- (2) Concrete barriers are not to be painted to eliminate tire marks.
- (3) Reflective delineators, placed as part of the original installation or retrofitted to meet special needs, should be maintained with the reflectors clear of material that obscures them. Missing or damaged reflective delineators should be replaced promptly.

**M5.01.3 Impact Energy Attenuators**

Energy attenuators are generally placed in areas of high traffic exposure. Routine surveillance should be performed to ensure that these devices remain functional. Detailed inspections should be made to ensure that the components are in satisfactory condition.

Damage that impairs the functional integrity of attenuators should be repaired as soon as possible. Less critical damage may be repaired in conjunction with other maintenance operations.

Debris should be periodically removed from under or around attenuators. The accumulation of large amounts of debris can hinder sliding action and impair the functioning of these devices and presents an unsightly appearance.

**M5.01.4 Roadside Markers**

Roadside markers should be maintained in an upright position, facing traffic and with reflectors clear of material that obscures them. Any markers or reflectors that are damaged or missing should be replaced to meet current standards. Post mile information (Rte-Co-P.M.) shall not be placed on markers that are not part of the Post Mile system. Metal or flexible posts may be used as needed to accommodate driving posts in hard or rocky soil.

## **M5.02 Uses and General Guidelines**

### **M5.02.1 Guardrail**

Guardrail is installed on State highways to reduce the combined effect of severity and frequency of "runoff the road" type accidents. This is accomplished by deflecting a vehicle away from embankment slopes or fixed objects and dissipating the energy of the errant vehicle.

Existing guardrail is to be maintained in accordance with the Department of Transportation Standard Plans. Any deviation to install, delete, or modify must be by prior approval of District Traffic Operations.

The approach ends of all guardrail installations are turned away from approaching traffic to minimize the probability of an end on collision. Both ends of guardrail installations are anchored to prevent failure of short sections of guardrail and minimize "pocketing" during a collision.

Guardrail anchored to a steel post, steel black out or concrete parapet requires as a back up plate, a 1 foot (.3048 meter) section of rail between the guardrail and post or metal black outs to provide reinforcement for the guardrail element.

Curved terminal sections are no longer installed on the trailing end of guardrail adjacent to one way roadways and are not to be maintained. Existing curved end sections on the trailing end of one way roadway guardrail may be salvaged for use as needed.

Posts of some breakaway terminals are wrapped with expanded polystyrene foam sheeting when they are set in the concrete foundations. Expanded polystyrene foam sheeting can be dissolved with a petroleum solvent (do not use gasoline) to facilitate removal of damaged posts. Damaged breakaway terminals must be replaced with acceptable current standard breakaway terminals.

Variable heights of guardrails are readily apparent to motorists, as well as being a potential safety problem and priority should be given to maintaining them to proper levels. Persons responsible for project reviews, construction and maintenance inspections should be alert to the potential need to adjust rail height because of pavement overlays.

Restoration of any damaged breakaway guardrail terminal is to be made by installing the current standard breakaway terminal as shown in the latest edition of the Standard Plans. Where field conditions prohibit the use of a standard 4 foot (1.2 meters) flare, proprietary end terminal systems may be used with appropriate approval. Contact the District Traffic Operations or Headquarters Maintenance Program for more information.

- (A) The following guidelines should be used when replacing damaged guardrail:
  - (1) Metal plate (Tuthill) guardrail is being phased out and will no longer be purchased.
  - (2) In all cases when nonstandard guardrail is damaged to the extent that a section or sections must be replaced, District Maintenance will immediately advise District Traffic Operations and corrective work will be initiated based upon their recommendations. Mixtures of old and new types of guardrail in a run should be avoided.
  - (3) When upgrading guardrail, current standards will apply as to post size and spacing, rail elements, anchorage and positioning. District Traffic Operations personnel will furnish Maintenance forces with the necessary guardrail design information.
- (B) Charges for replacement upgrading of damaged guardrail will be apportioned as follows:
  - (1) The cost of "replacement in kind" of the damaged guardrail to be shown on the damage report should be an estimate based on the District's prior charges for similar work.
  - (2) Capital outlay costs (upgrading) will be the actual cost of replacement to current standards, less the amount for "replacement in kind" shown on the damage report.
  - (3) When any upgrading by Maintenance forces is involved in a replacement of damaged guardrail a specific work order is required incorporating the split-funding provisions. Most Districts have blanket type improvement E.A.'s to fund this type of work. Work involving upgrading is to be reported in the Y family, Work for Others. When possible, upgrading of guardrail should be accomplished by contract.

#### **M5.02.2 Median Barriers**

Ideally, median barriers should do the following:

- (A) Prevent an out of control vehicle from crossing the median and colliding with opposing traffic.
- (B) Prevent the deflection of a vehicle colliding with the barrier back into the traffic stream.

- (C) Decelerate the errant vehicle within humanly tolerable limits.

See California Standard Plans for flares and special conditions covering median barrier installations.

- (A) Thrie Beam Barrier

Thrie beam barrier is a type of metal beam barrier that has rail elements containing 3 ribs that are 20 inches (.508 meters) high. There is no channel rail. The top of the rail is 32 inches (.8128 meters) above the ground.

- (B) Metal Beam Barrier

The top of metal beam median barrier is 30 inches (.762 meters) above the ground beneath the rail.

The top of the posts are level with the top of the rail element. The blocks extend approximately 1 inch (25.4 millimeters) above the top of the posts and rail elements.

- (C) Cable Barrier

With cable barrier, the height of the two 3/4 inch (19.5 millimeters) cables should be between 27 and 28 inches (.6858 and .7112 meters) above the ground.

Emergency openings in cable barrier must be secured after use. Failure to do so reduces the effectiveness of a substantial length of cable barrier.

Research indicates that consolidated sand is a satisfactory filler material in lieu of asphalt for use in cable barrier post footing sockets. As a result, dry, clean, commercial quality concrete sand may be used as an alternative filler material in "Type B" cable barrier footings. The sand should be consolidated and compacted in the post socket by a minimum of 25 hammer blows to each side of the post.

- (D) Concrete Barrier

The top of the current standard, Type 50, concrete median barrier is 32 inches (.8128 meters) above finished grade. Present design of the barrier does not call for a below ground footing except at ends or joints in the barrier. The Standard Plans indicate the location and amount of steel reinforcement in the barrier. The Type 60 single slope concrete median barrier, has been installed in some areas of the State.

The standard height for the Type 60 barrier is 36 inches (.9144 meters) although 32 inches (.8128 meters) and 56 inches (1.4224 meters) tall barriers may be installed as field conditions dictate.

#### **M5.02.3 Impact Energy Attenuators**

Energy attenuators are intended to reduce the severity of a collision with a fixed object that cannot be removed or protected by other types of protective systems.

Attenuators are expensive to install and maintain. Special problems or unsatisfactory performance should be immediately brought to the attention of District Traffic Operations.

Type R chevron markers should be installed on the front of the attenuators whenever traffic may proceed on either side of the installation. The point of the chevron should be at the top of the marker.

##### **(A) Collapsible Units**

Present designs of water filled plastic tube, and lightweight crushable canister attenuators use overlapping fender panels along the sides of the assembly. These systems are held in position by anchor cables and use a backup structure. Water filled units are no longer used on new construction and should be replaced when no longer serviceable.

Successful operation of sliding type units depends to a large extent on keeping the area free from objects and debris that can resist movement of the units. Care must be taken in machine sweeping to assure that there is no excessive buildup of debris within the device.

##### **(B) Sand Filled Units**

Sand filled plastic barrels are free standing and approximately 3 feet (.9144 meters) in diameter by 3 feet (.9144 meters) high. These barrels contain specific weights of sand depending upon their location in the installation. Sand filled barrels may "walk" or move downhill when installed on a slope. When this occurs, a stop or restraint is needed for each barrel.

Location of the barrel in the array and weight of sand in the barrel are critical in determining how the unit functions when impacted.



Whenever possible, location and weight of the barrels should be painted on the pavement to facilitate replacement. If this is not possible (e.g., installations in unpaved areas), weights can be marked on a marker Post Plate.

Copies of "As Built" plans can also be used to supply the information. Marking the weight on the sides of barrels or on the lids is unsatisfactory since these notations are lost in most impacts. Contact District Traffic Operations when no other information is available.

Sand used in filling barrels must be capable of remaining in a loose condition throughout the expected life of the barrel. Sand that contains clay particles, or is not well graded, is capable of exerting excessive stresses during expansion/contraction of the barrels and can cause premature failure of the unit. Cohesive materials can also result in failure of the array to dissipate energy when impacted by a vehicle.

Until further modified by the Engineering Service Center, Office of Materials Engineering and Testing Service, the following recommendations should be followed in filling barrels.

"The sand used to fill modules shall be a clean washed concrete sand of commercial quality conforming to the sieve analysis requirements of ASTM C33- with no more than 1 percent of the sand passing the No. 200 sieve. The sand must not contain clay lumps.

Bagged sand shall not be used. At the time of placing in the modules, the sand shall not contain more than 7 percent water, as determined by Test Method No. Calif. 226."

Laboratory tests have shown that sand filled crash cushions will function correctly when "Energite" and "Fitch" sand barrels are mixed.

Lids should be fastened to the sand barrel shell consistent with the manufacturers recommendations. This is to minimize the scattering of debris during an impact. Some sand barrel lids have traveled a considerable distance. The placement of 4 pop-rivets, spaced equal distance, around the barrel are satisfactory.

#### **M5.02.4 Roadside Markers**

Roadside markers comprise the various permanent devices, excluding signs, used off the traveled way to guide the motorist and warn of restricted width and/or identify or mark locations along the highway. Instructions for use of roadside delineators, object markers, and channelizers are included in the Traffic Manual.

- (A) Flexible delineators will generally be used for maintenance replacements unless the following conditions are met:

- (1) Where it is necessary to attach snow poles to posts.
- (2) In rocky areas or hard ground where steel posts have some advantage in driving.

Consideration may be given to the possibility for using a two part, metal base post system in these areas.

- (3) In protected areas where posts are not exposed to traffic (such as behind guardrails and in front of structures).
- (4) When there is a need to support post mile markers.

Decisions regarding locations on existing roads which warrant the use of flexible delineator posts shall be the responsibility of District Maintenance in consultation with District Traffic Operations. Circumstances of weather, snow removal, difficulty of installation or other special needs will dictate when metal markers are required.

Any widespread District program to upgrade undamaged installations to provide uniformity of appearance is considered "improvement work" and cannot be done using maintenance funds.

Replacement and salvage of guide markers in good condition is not generally cost effective. An exception may be considered where, after knocked down markers have been replaced, the remaining metal guide markers in good condition on a particular ramp or curve represent 25 percent or less of the total number of delineator posts. In this case, replacement of the remaining metal markers for the sake of uniform delineation treatment may be considered.

Excess markers are a needless expense to install and maintain and should be avoided whenever possible. However, except for culvert markers and clean out markers used by Maintenance, all markers on the system should be maintained unless directed otherwise by the District Traffic Engineer.

- (B) Delineators

The purpose of delineators is to indicate the roadway alignment and to accent critical locations. Delineators should not be used for other purposes. The practice of using them to mark drainage structures, pull boxes, underground utilities, etc., should be discontinued.

All delineators shall be reflectorized where night use is anticipated. Reflective elements should have a minimum dimension of 3 inches (76.2 millimeters).

Elongated reflective units of appropriate size may be used in lieu of two or three multiple reflectors.

Uniformity of type, color, and positioning of reflectors to delineate the roadway is essential. All proposed deviations from the patterns shown in the Traffic Manual, should be cleared by the District Traffic Engineer.

The overall line of delineators should parallel the roadway centerline as closely as possible. When possible, delineators should be placed 2 feet (.6096 meters) outside the edge of the usable shoulder but not more than 12 feet (3.6576 meters) from the pavement edge. In curbed sections, the markers will be placed 2 feet (.6096 meters) outside the face of the curb.

**(C) Clearance Markers**

Clearance markers are used to indicate obstructions or restrictions in width to the right of traffic, including bridge and culvert rails. They should be placed for all major obstructions in the plane of the roadway and within 4 feet (1.2192 meters) of the edge of shoulder. On divided highways, clearance markers are also used to the left of traffic for the same purpose. All clearance markers are reflectorized for night visibility.

Clearance marker posts are placed on a line with the edge of the obstruction nearest to the pavement. When placed in conjunction with guardrail on bridge approaches, the clearance markers are located immediately behind the guardrail and at sufficient height to make all reflectors visible to approaching traffic.

**(D) Culvert Markers**

Culvert markers are placed as a convenience to maintenance crews in marking locations of culvert openings. Such marking is sometimes necessary to protect culvert ends from damage from adjacent operations as well as to serve as an aid in locating culverts during storm conditions.

Most culverts can be located without the use of markers and in such cases, and if protection is not needed, markers need not be used. When culverts are difficult to locate, markers may be placed on each side of the roadbed, above the culvert. They may be placed either outside or in line with a series of markers.

Culvert markers should not be reflectorized except where the marker is well off the traveled way and locating the culvert could be a problem during hours of darkness. The possibility that the culvert marker might be mistaken for a road delineator should be avoided.

Culvert markers are not part of the post mile system for identifying locations and post mile markings (Rte.-Co.-P.M.) are not to be stenciled on replacement culvert markers.

If needed for maintenance identification of a particular culvert, crews should stencil only the numerical value of the post mile (not route and county) on new or replacement markers.

Removal of excess culvert markers may be done at any time as part of routine maintenance operations. Revision of existing markers to eliminate reflectorization and post mile markings, should be performed whenever the marker requires replacement for other purposes.

**(E) Emergency Crossover Markers**

See current Traffic Manual instructions (Section 6-04.7) on marking median crossovers provided for emergency vehicles on freeways. Markings for abandoned or obliterated crossovers should be removed.

Fencing and or gates at crossover locations, to prevent unauthorized use, is strongly discouraged, except in the most unusual circumstances. Acceptable locations for the establishment of gated crossovers would be for use for incident management detours or snow removal operations.

**(F) Post Mile Markers**

The post mile marker is an integral part of the post mile system and is used by traffic officers, maintenance personnel and others to locate specific incidents or features on the roadway with respect to the post mile system. Post mile markers should not be used for additional marker functions, and other type markers should not be used as pastille markers. The post mile marker shall indicate the route, county, and post mile of the installation; only post mile markers shall contain the route and county designation.

The lettering size shall be 2½ inches (63.5 millimeters) letters for county, route and post mile fraction (hundredths/millimeters). The post mile numerals shall be 4 inches (101.6 millimeters) in height.

Post mile markers shall not be reflectorized. When installed behind guardrail, the marker should be placed so that the entire legend is readable from the road.

Stenciling of the pastille on concrete median barriers is permissible in addition to, but not in place of, the regular post mile markers located along the outer shoulder. This is an additional aid for maintenance and accident investigation forces.

District Traffic Operations shall have the responsibility to verify the accuracy of the placement of post mile markers. All post mile markers should be located to an accuracy of 50 feet (15.24 meters) (0.01 (.016093 kilometers) mile) on the ground. The value shown on the marker shall be to the nearest 0.01 of a mile (.016093 kilometers of a kilometer) and shall reflect the mile (kilometer) point of the centerline opposite the marker location. If any are found to be more than +/- 0.01 (+/- .016093 kilometers) mile from the intended location, they must be relocated.

Periodic field review and inspection should be conducted to locate damaged or illegible markers. Reports of incorrect post mile markers may originate from various sources.

The District Traffic Operations and the Roadway Records unit of Headquarters Traffic Program must be in agreement as to which field markers will be corrected and which accident records will be relocated before any action is initiated. Care must be taken in replacing damaged markers to assure that the new marker is installed in the same place as the old marker.

**(G) Miscellaneous Markers**

Roadside markers are sometimes used to mark the location of pull boxes, survey monuments, water line crossings, etc. Where such items are readily visible or can be found easily, marker posts should not be installed. These markers shall not be reflectorized. When placed adjacent to the shoulder the markers should face approaching traffic.

**M5.03 Installation/Maintenance Details and Checklists**

Installation standards and drawings for traffic safety devices may change as new materials, equipment, and traffic needs are identified. Be sure that the latest information is used for any new installation.

District Traffic Operations will provide current standards for each installation. Supervisors are responsible to assure that current drawings and standards are available for performance of work.

**M5.03.1 Metal Beam Guardrail, Thrie and Metal Beam Median Barriers**

- (A) Check the plans. Know what the design requires.
- (B) The 6 inch (152.4 millimeter) side of 6 inch x 8 inch (152.4 x 203.2 millimeters) timber posts should be next to the rail.
- (C) The posts should be set to the full depth shown on the plans. If this is not possible due to the presence of spread footings or other underground obstruction, some acceptable alternative method of setting the posts securely should be used. The Standard Plans contain some alternatives. Others may be obtained through the Construction Program or District Traffic Operations.
- (D) All rail laps should be in the direction of traffic adjacent to the rail.
- (E) Splice bolts should be tight with full bearing on the rail and not on bolt shoulders. The recess in the nut should face the bolt shoulder otherwise the splice will not be tight.

Use all the splice bolts the plans call for.

- (F) Bolts should be long enough, so that nuts, are threaded completely onto the bolt. A one or two thread connection is not satisfactory. This should be checked, especially at connections to structures.
- (G) Excessive bolt "stick through", exposed threads beyond the nut, more than ½ inch (12.7 millimeters) should be cut off. This is especially important where there is pedestrian or bicycle traffic behind the barrier. Excessive bolt length on beam barrier can increase sheet metal damage in otherwise minor collisions by vehicles. Threaded ends of bolts shall not be placed on the traffic side of the rail.
- (H) Rail elements should be at the proper height for the type of barrier being installed.

Where the rail element is too low, less than 27 inches (.6858 meters) for guardrail, there is an increased chance that a vehicle may go over the top of the guardrail. Where a guardrail element is too high, more than 27 inches (.6858 meters), there is an increased chance of a small vehicle snagging on a post below the rail.

- (I) The area in front of barriers should be flat and smooth, free of berms, dikes, curbs, windrows, watering basins, and ruts.

- (J) Anchor cables should be taut with no obvious slack in the cable. This will ensure that tension is quickly developed in the rail element during a collision and minimize any tendency towards pocketing of the vehicle.
- (K) Concrete anchors and footings should be built according to dimension shown in the plans. Undersized footings, where soil has caved into the hole before concrete was placed, have been torn out of the ground by impacting vehicles.
- (L) Roadside rails may have longer posts or other design modifications when installed where the ground is loose or where there are steep side slopes. These modifications are made to provide additional strength to the rail. Be alert in recognizing these installations so they can be maintained as constructed.
- (M) Where cable clips are used, the saddle of the clip should be on the live or load carrying end of the cable. If not, the cable can slip, the rail will not develop full tension and a vehicle can penetrate the guardrail. A simple reminder is: "Never saddle a dead horse".
- (N) The approach ends of all guardrail installations should be flared back away from traffic.  
  
Setbacks for flares are shown in the Standard Plans. The flares reduce the end on stiffness of the rail and reduce the chance of a rail penetrating a vehicle in an impact.
- (O) Avoid, if possible, making "off the cuff" field changes in planned installations. Small changes in an installation can result in greatly different performance during a collision.
- (P) Where there is a problem, or if something is not clear, ask questions. Seek help through your District or Headquarters office.
- (Q) Guardrail and barriers do not prevent accidents. They only modify the consequences of an accident. If you observe something that does not work the way it should, either in building it, maintaining it, or in expected performance, pass the word on. This is one of the ways we can have safer highways.

#### **M5.03.2 Sand Filled Impact Energy Attenuators (Cushions)**

- (A) Check the plans. Know what the installation requires.
- (B) Read manufacturer's installation instructions. Changes can occur. There are differences in manufacturer's designs.
- (C) Don't install barrels on soft ground or uncompacted AC. The barrels will sink in unevenly, distorting the barrel and eventually leading to failure.

- (D) Open bottom (Fitch) barrels should not be installed on bare ground. Rodents can burrow underneath and into the barrel. An AC pad may prevent this. Also, water can more readily soften the ground under such barrels leading to its eventual failure.
- (E) Barrels should not hang over curbs on raised gore surfaces.
- (F) Weight of sand should be painted on pavement under or beside the barrel. This makes repairs easier.
- (G) Maintenance crews responsible for maintaining sand filled cushions should get a set of plans or drawings for each project showing the sand barrel pattern and sand weights in each barrel. This is especially important where sand weights have not or cannot be painted on the ground.
- (H) Lids should be pop-riveted to shells on Fitch barrels to minimize the lids flying about during an impact. The new lids are heavier, weighing 8 pounds to 10 pounds (3.6288 kilograms to 4.536 kilograms). If it is necessary to secure Energite lids on barrels, they should be pop-riveted.
- (I) Energite Inner Cones and Fitch Sand Support Structures, should be installed in accordance with the manufacture's instructions to ensure proper performance. Sand should be added to the levels indicated on the sides of the barrels.
- (J) Be sure that the sand meets specifications. Cleanliness is most important. Dirty sand can cake and result in split barrels. Very fine sand may slowly leak out. Do not use sand in bags use only loose sand.
- (K) Check the amount of sand in all barrels. Weights should conform to those shown on the plans.
- (L) Barrels with cracks through the walls that are permitting sand to leak out should be replaced as soon as possible. This assures the proper performance of the crash cushion.
- (M) If something is not understood or if you have questions, be sure to ask. The Programs of Construction, Traffic Operations, Highway Maintenance, or New Technology and Research, may have the answer to your problem.

#### **M5.04 Out of Control Vehicle Ramps**

Arrestor bed escape ramps require smoothing after every entry. An aggregate bed that contains humps and hollows can be very difficult to traverse and may unnecessarily damage the truck.



Thus, it is essential that the aggregate bed be reshaped as soon as possible after a vehicle has been removed from the gravel.

Gravel tends to pack with time or repeated traversals by equipment. Thus, the gravel should be loosened up or scarified after each ten uses of the ramp or every six months (Spring and Fall), whichever occurs more frequently. Whenever the gravel is scarified it should be examined for contamination. Then, if an excessive amount of fine material or other contaminants is noted, immediate provisions should be made to replace or reprocess the aggregate to original specifications. Another indicator that the aggregate is becoming contaminated is when vehicles using the ramp travel increasing distances along the ramp. Use of the proper grade of stone cannot be over emphasized due to the potential liability.

Maintenance of an arrestor bed escape ramp requires adequate equipment. Hand tools are not acceptable. Proper power equipment assures that the ramp will be back in service in a minimum amount of time. It also ensures that maintenance workers will be minimally exposed to the chance of a runaway truck wanting to use the ramp.

Equipment considerations may include a motor grader with an extension on its blade so the final pass in smoothing the gravel may be made from the service road. Another possibility is using a snow cat or some other light footprint vehicle. Since escape ramps are located in mountainous terrain and their use is more frequent in warm weather, the availability of snow cats is a possibility.